MST eNEWS

July 2012



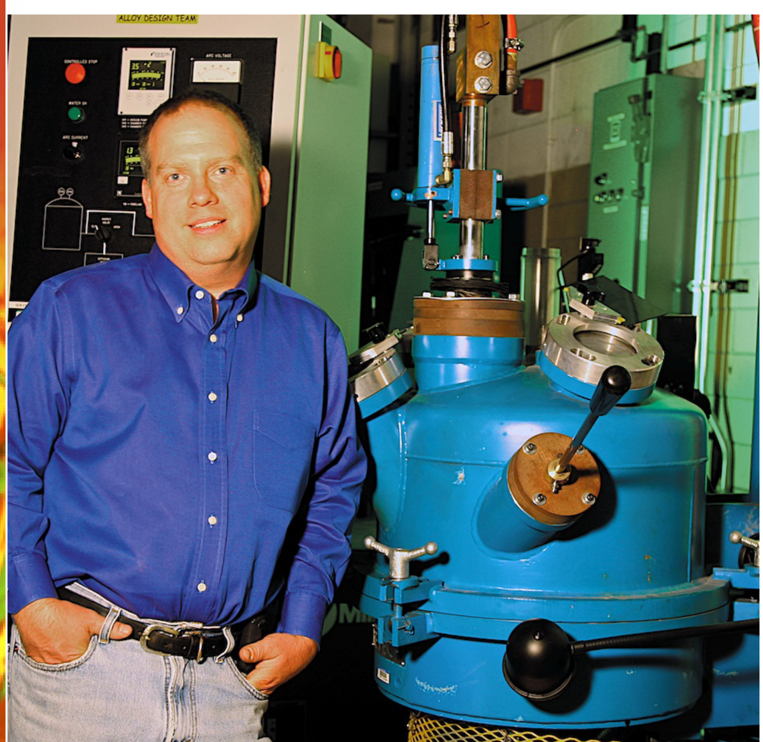
# Jason Cooley

## *Peering into previously inaccessible realms*

By Diana Del Mauro
ADEPS Communications

Surrounded by towers of books, boxes of magnets, bottles of precious metals, and a pot of hot coffee, Jason Cooley seeks a balance between management and research at his office in the Sigma building. Ensuring his team's safety and security are important responsibilities, yet he remains committed to the science being performed. As a result, the team can rely on him to mentor a new generation of staff, even guiding the team onto experiments that could revolutionize metal processing science.

"It's hard, but it is worth doing," he said of keeping his hands dirty in the lab while serving as Alloy Design and Development team leader in Materials Technology-Metallurgy (MST-6). "I'm not really happy if I'm not doing something like this."




*Jason Cooley uses this arc-melter to make metal alloys for various experiments.*

Cooley recently developed a promising technique for processing materials in the non-traditional extreme environment of high magnetic fields. He's also a co-investigator on an experiment exploring novel methods for interrogating materials during processing.

"The pie-in-the-sky vision," Cooley said, is to create new, desirable materials by actively controlling properties such as grain size distribution during the manufacturing process. "Right now we guess a lot based on experience and are often wrong," he said.

Creating microstructures by design is one of the grand

*continued on page 2*

**Cooley...** challenges for synthesis and processing science. Being able to see and predict certain properties during casting are two important steps, which explains why Cooley is so engrossed in what he's doing.

Using a magnetic field to align crystallites in a specific direction, Cooley's research team is getting closer to dictating what happens to a material during casting, independent of temperature, pressure, and composition.

Metals and alloys are polycrystalline materials comprised of tiny metallic grains, like pieces of sand stuck together. Sometimes the grains are identical; sometimes they vary in size, composition, and crystallographic orientation. Orientation matters because some materials can be strong or hard in one direction and weak or soft in another. When a metal solidifies and cools, variables such as temperature gradients, cooling rate, and alloy composition affect how crystallites, which form during the melting process, will grow, eventually bumping into each other. Alloys often separate into phases with different chemical compositions. Such factors determine the arrangement of crystallites and the resulting physical properties of the metals or alloys.

"Until recently it was impossible to peer into a metal while it was solidifying and watch these things happen," Cooley said. "We couldn't measure precisely what happened during cooling and therefore, couldn't build predictive models based on physics. Now we can peer inside with proton beams and x-ray beams to see what happens in real time, and that's a big deal."

As part of his co-investigator project with Amy Clarke (MST-6), Cooley helped opened a window for seeing these microstructural changes unfold. He designed furnace equipment for an experiment that shines protons through thick, dense metals at the Laboratory's Proton Radiography facility, a new application of the Los Alamos-invented technique for materials studies.

"It's fun to do stuff that's on the cutting edge," said Cooley, who holds a doctorate in physics from the University of Michigan and has been team leader since 2005.

MST-6 Research Technologist Tim Tucker described Cooley as a hands-on manager who explains the science—as well as the safety and security aspects—behind experiments. "He's the type of person who wants to get in the lab and show you what you need to do and how to do it," Tucker said.

Cooley knows just how valuable lessons in the lab are: "I couldn't have done the things I have done without assistance and mentoring from a lot of people."

# Cerreta joins faculty of Washington State University

Ellen Cerreta, Dynamic and Quasi-static Loading Experimental team leader in Materials Science in Radiation and Dynamic Extremes (MST-8), has been made an adjunct faculty member at the Institute of Shock Physics at Washington State University (WSU).

As such, she was recently invited to present a seminar at the university on "Small Scale Experiments to Support Strength and Damage Models." As part of this new role, she will co-mentor graduate students with other faculty members at WSU specifically in the area of dynamic damage characterization.

Cerreta received her BS from The University of Virginia and her PhD in materials science and engineering from Carnegie Mellon University. Upon graduating, she accepted a postdoctoral position, and subsequently a staff member position at Los Alamos National Laboratory. Her research focuses on the quantification of quasi-static and dynamic deformation evolution to advance next-generation, mesoscale damage models.

*Technical contact: E. Cerreta*

*Ellen Cerreta loads metallographic sample into XL30 SEM equipped with electron backscatter diffraction detector.*

# Cooling solids to cryogenic temperatures with a laser

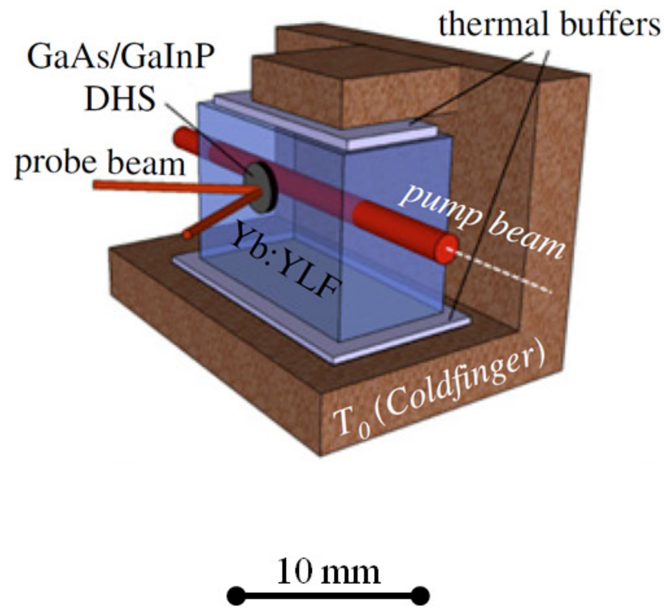
A team of researchers from Polymers and Coatings (MST-7) and the University of New Mexico recently presented their assessment of the state of cryogenic optical refrigeration in a review article in *Advances in Optics and Photonics*.

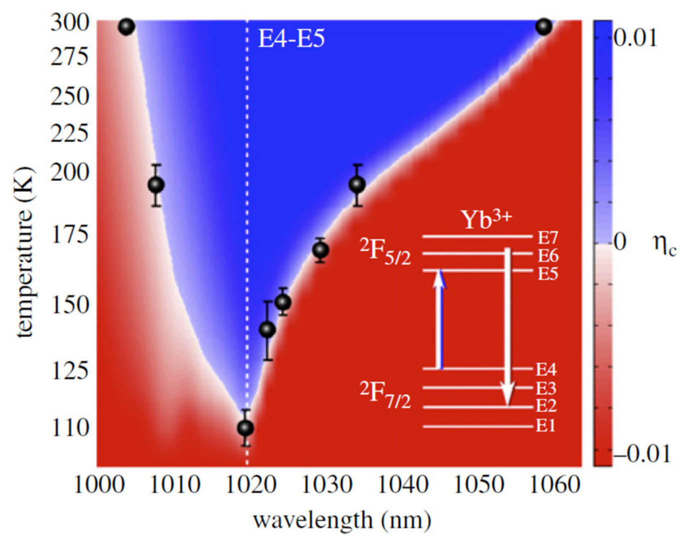
The team of Markus Hehlen (MST-7) and Denis Seletskiy, Richard Epstein, and Mansoor Sheik-Bahae (UNM) has led the UNM/Los Alamos solid-state laser cooling collaboration for the past 10 years. Research into solid-state optical refrigeration originated with the 1995 Los Alamos discovery of cooling bulk glass by exciting it with a laser.

Laser cooling had previously only been observed at the atomic scale. Richard Epstein (Laboratory Fellow, retired) and co-workers only achieved 0.3 K of cooling at the time, however, the prospect of cooling macroscopic solids with a laser and creating practical optical refrigerators that have no moving parts was enough to spawn a new area of research.

The collaboration between the Laboratory and the University of New Mexico has remained at the forefront of this field. The team's recent review on cryogenic optical refrigeration (*Advances in Optics and Photonics*, **4** (2012) 78-107) describes the principles of solid-state laser cooling, presents the experimental verification of model predictions, and assesses opportunities and challenges for developing practical laser coolers. Transformational advances have recently been made, and the researchers have now demonstrated laser cooling of an ytterbium-doped fluoride crystal (Yb:$LiYF_4$) down to a cryogenic temperature of 115 K from room temperature. The figure shows cryogenic laser cooling in a Yb:$LiYF_4$ crystal and excellent agreement with model calculations.

Experiments are underway to reach sub-100 K temperatures in the near future. This performance is sufficient to enable laser-cooling devices that may be used to cool electronics and sensors in satellites and instrumentation applications. The recent work was funded by the Air Force Office of Scientific Research (AFOSR) and the Defense Advanced Research Projects Agency (DARPA).
*Technical contact: Markus Hehlen*




*Top: Typical arrangement of a solid-state optical refrigerator experiment. Bottom: Measurement (solid circles) and model calculations (colored areas) of minimum laser-cooling temperatures in Yb:$YLiF_4$.*

# Amy Clarke honored with Presidential Early Career Award for Scientists and Engineers

Amy J. Clarke (Materials-Metallurgy, MST-6), is among the honorees that President Obama named today as recipients of the Presidential Early Career Award for Scientists and Engineers (PECASE).

"Discoveries in science and technology not only strengthen our economy, they inspire us as a people." President Obama said. "The impressive accomplishments of today's awardees so early in their careers promise even greater advances in the years ahead."

This is the highest honor bestowed by the U.S. government on outstanding scientists and engineers who are early in their independent research careers. Clarke is among 13 U.S. Department of Energy affiliated awardees being recognized for their efforts in a variety of fields – from advances in power electronics for the electric grid to innovations in solar hydrogen production and from work in scientific computation to studies of possible new physics beyond the Standard Model. DOE nominated the awardees and a variety of DOE's program offices is funding their work.

"As I look to future challenges in national security science, many of them deal with materials science and the ways materials behave under extreme conditions," said LANL Director Charlie McMillan. "Amy is an excellent example of the generation of scientists who will tackle – and overcome – those challenges."

The winning LANL scientist is among 96 researchers supported by the various federal departments and agencies who will receive the PECASE. In addition to a citation and a plaque, each PECASE winner continues to receiving DOE funding for up to five years to advance his or her research. The scientists and engineers have traditionally received their awards at a White House ceremony.

Clarke was nominated by the National Nuclear Security Administration of the Department of Energy for her research on uranium niobium alloy deformation mechanisms using micro-pillar compression testing to determine the influence of orientation on stress-strain response, for using in situ solidification and proton radiography with potential to finally resolve liquid-solid processing questions relevant to nuclear weapons, and for mentoring future ferrous metallurgists.

Clarke received a doctorate in metallurgical and materials engineering from the Colorado School of Mines. She is a former Seaborg Institute postdoctoral fellow at Los Alamos and a recipient of The Minerals, Metals & Materials Society Young Leaders Professional Development Award.

**This is the highest honor bestowed by the U.S. government on outstanding scientists and engineers who are early in their independent research careers.**

Earlier in 2012, she was named a recipient of a DOE Early Career award for her project, In-situ Monitoring of Dynamic Phenomena during Solidification, focusing on the ability to visualize experimentally and model theoretically the melting and solidification processes of metal alloy materials, even at elevated temperatures.

The PECASE awards are intended to recognize some of the finest scientists and engineers who, while early in their research careers, show exceptional potential for leadership at the frontiers of scientific knowledge during the twenty-first century. The awards foster innovative and far-reaching developments in science and technology, increase awareness of careers in science and engineering, give recognition to the scientific missions of participating agencies, enhance connections between fundamental research and national goals, and highlight the importance of science and technology for the nation's future.

# HeadsUP!

## WSST Fest a success

Laboratory workers had the opportunity to learn about employee-driven safety programs and successes at the recently held WSST Fest. The event included information booths by organizational Worker Safety and Security Teams, a safety showcase with safety products and services from Laboratory suppliers, and health screening sessions for employees. To see a slideshow of the event, please see int.lanl.gov/news/newsbulletin/QuickTimes/wsst-fest-2012.mov.

## New home for Employee Assistance Program

The Employee Assistance Program has moved to the Occupational Medicine building at TA-3 from the Los Alamos Neutron Science Center.

The EAP is a counseling and referral service that assists employees in addressing behavioral health issues. Its phone number remains 667-7339. EAP's free, confidential counseling services are available to all badge holders and their family members. Questions? Contact James Barber or Lisa Celosse at 667-7339.

## Reminder: Rains are here, but continue practicing fire safety

Increased humidity and rain has lessened fire danger on LANL property and in the nearby forests. But LANL emergency operations managers remind employees to continue practicing fire safety.

Employees should:

- Smoke only in designated smoking areas and discard cigarette butts in proper receptacles.
- Don't park cars along shoulders in forest roads; engines running can emit sparks that start a fire.
- Report, and if possible, remove downed branches, heavy growth of shrubs that can ignite and quickly explode into a large fire.
- Practice defensible space at work and at home.

Employees are reminded to call 9-1-1 if they spot a fire on or off Lab property, and to call Emergency Operations at 7-6211 if they spot a potential hazard, such as a power line that may be in danger from a tree or a downed power line. Employees also should call Emergency Operations if they encounter wildlife.

## *Celebrating service*

Congratulations to the following MST Division employees celebrating service anniversaries this month:

| | |
|---|---|
| Patrick Hochanadel, MST-6 | 15 years |
| Thomas Lienert, MST-6 | 10 years |

*Valle clouds, Robb Kramer*

MST e NEWS

Published monthly by the Experimental Physical Sciences Directorate.
To submit news items or for more information, contact Karen Kippen, ADEPS Communications, at 606-1822, or kkippen@lanl.gov.

LALP-12-007

Los Alamos National Laboratory, an affirmative action/equal opportunity employer, is operated by Los Alamos National Security, LLC, for the National Nuclear Security Administration of the U.S. Department of Energy under contract DE-AC52-06NA25396. A U.S. Department of Energy Laboratory.